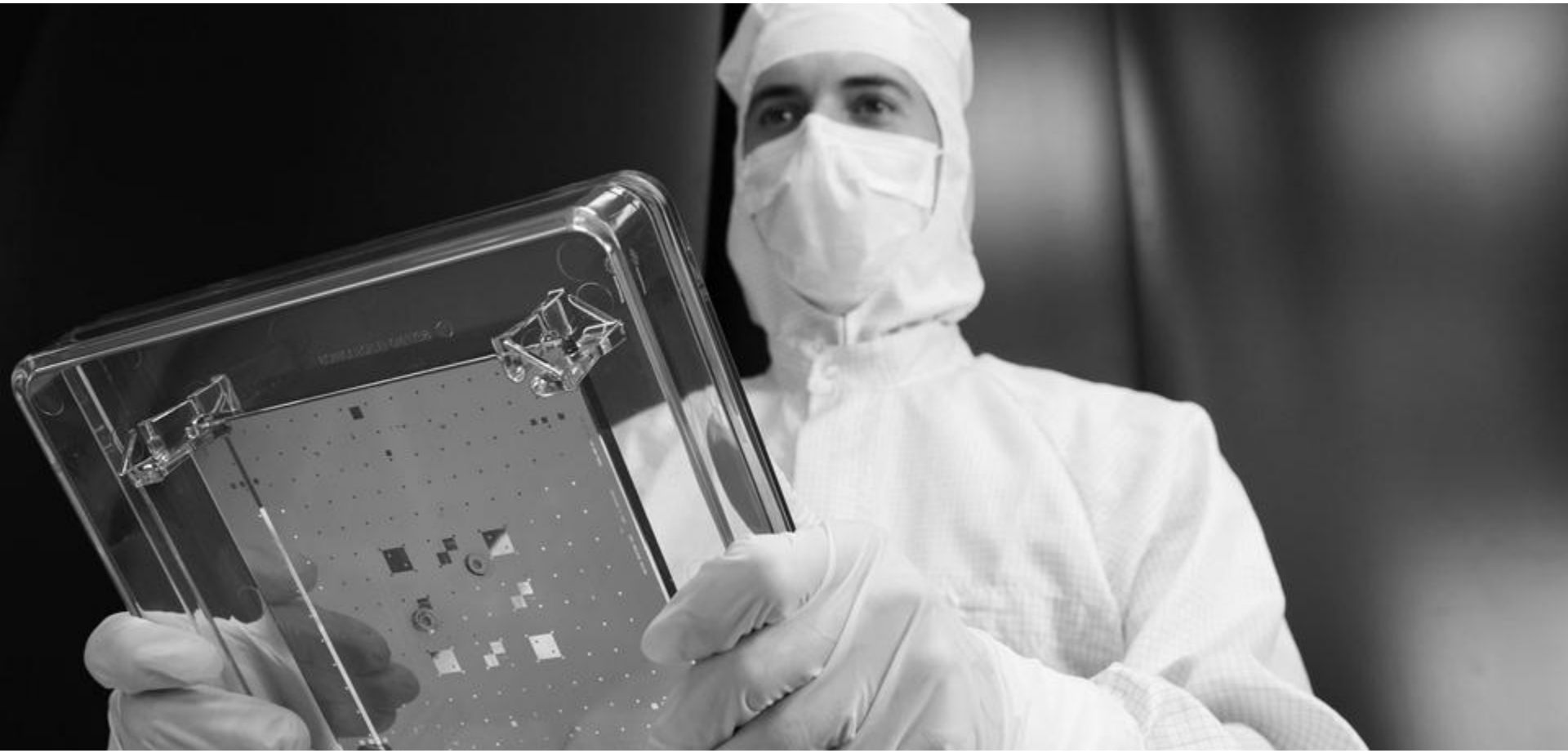
Simulation Results from the AIMS™ EUV Development Project



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Brussels, 1. Oct. 2012

Agenda

1. Introduction
2. Tool Layout Overview
3. Simulation Results
4. Summary

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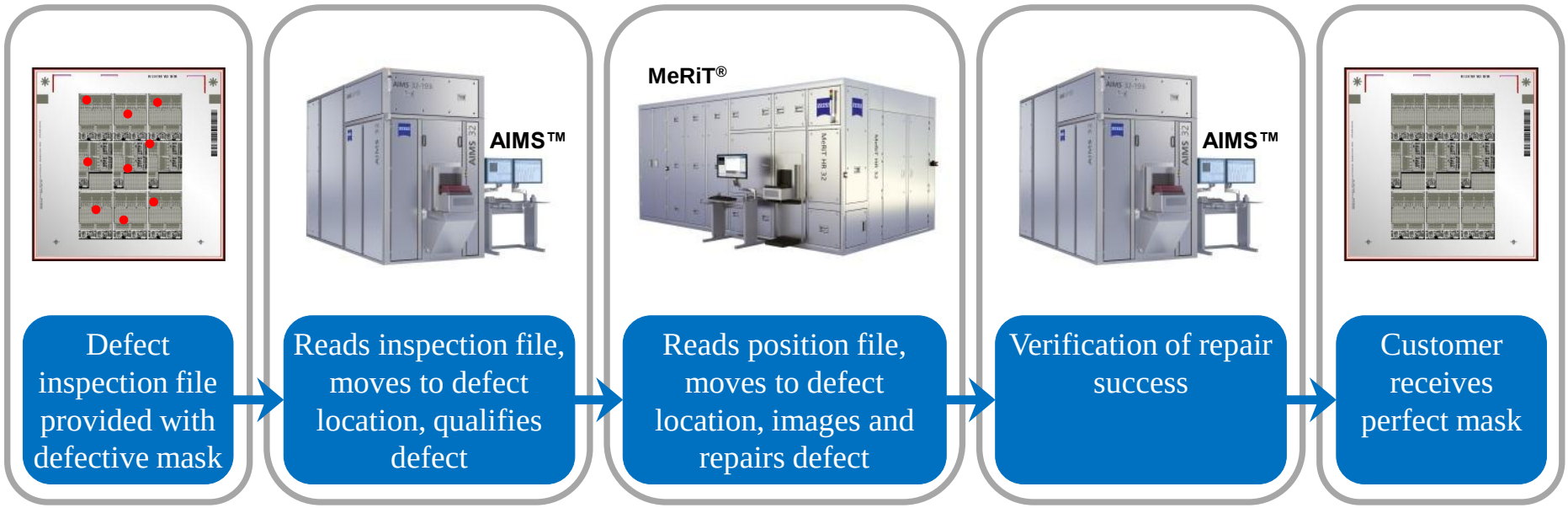
Photomask closed loop defect solution

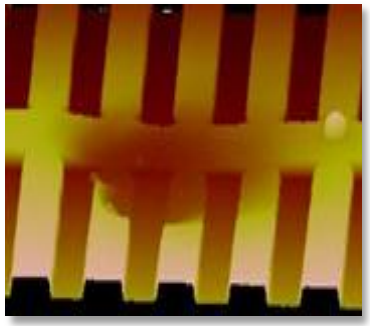


- AIMS™ allows defect qualification based on the aerial image produced by scanner like illumination
  - Verifies that defects are printable and require repair
  - Verifies that repair is successful

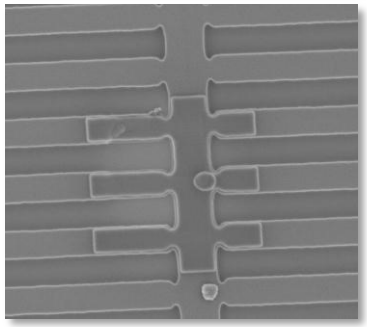
- MeRiT® provides repair solutions for a wide variety of defects

EUV mask defects and repairs must be qualified before printing wafers

AFM image of EUV defect



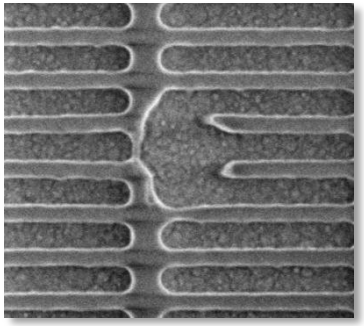
SEM image of EUV repair



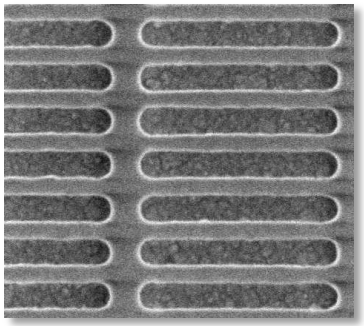
Will this defect print?

Will this repair pass?

SEM image of wafer print



SEM image of wafer print

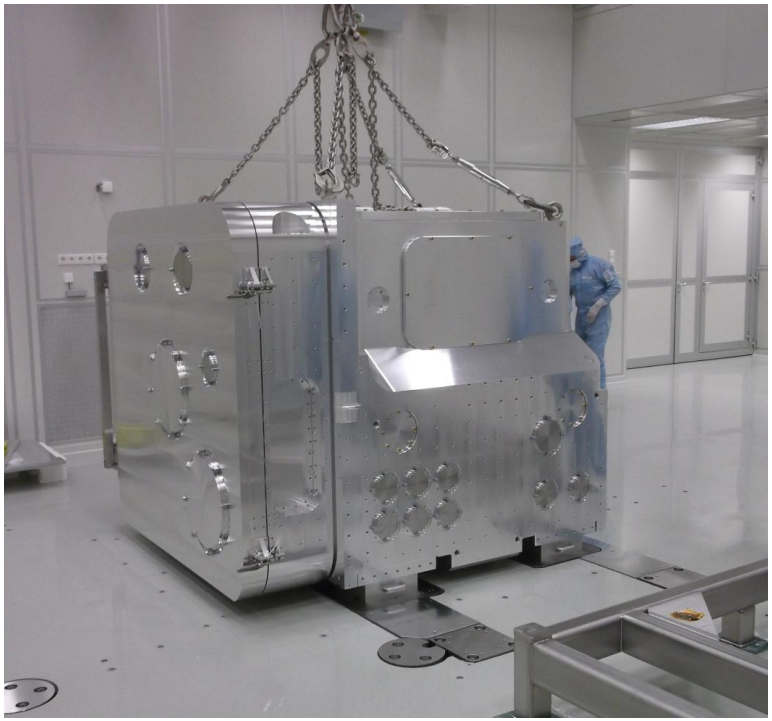


AIMS™ EUV provides this information, BEFORE printing

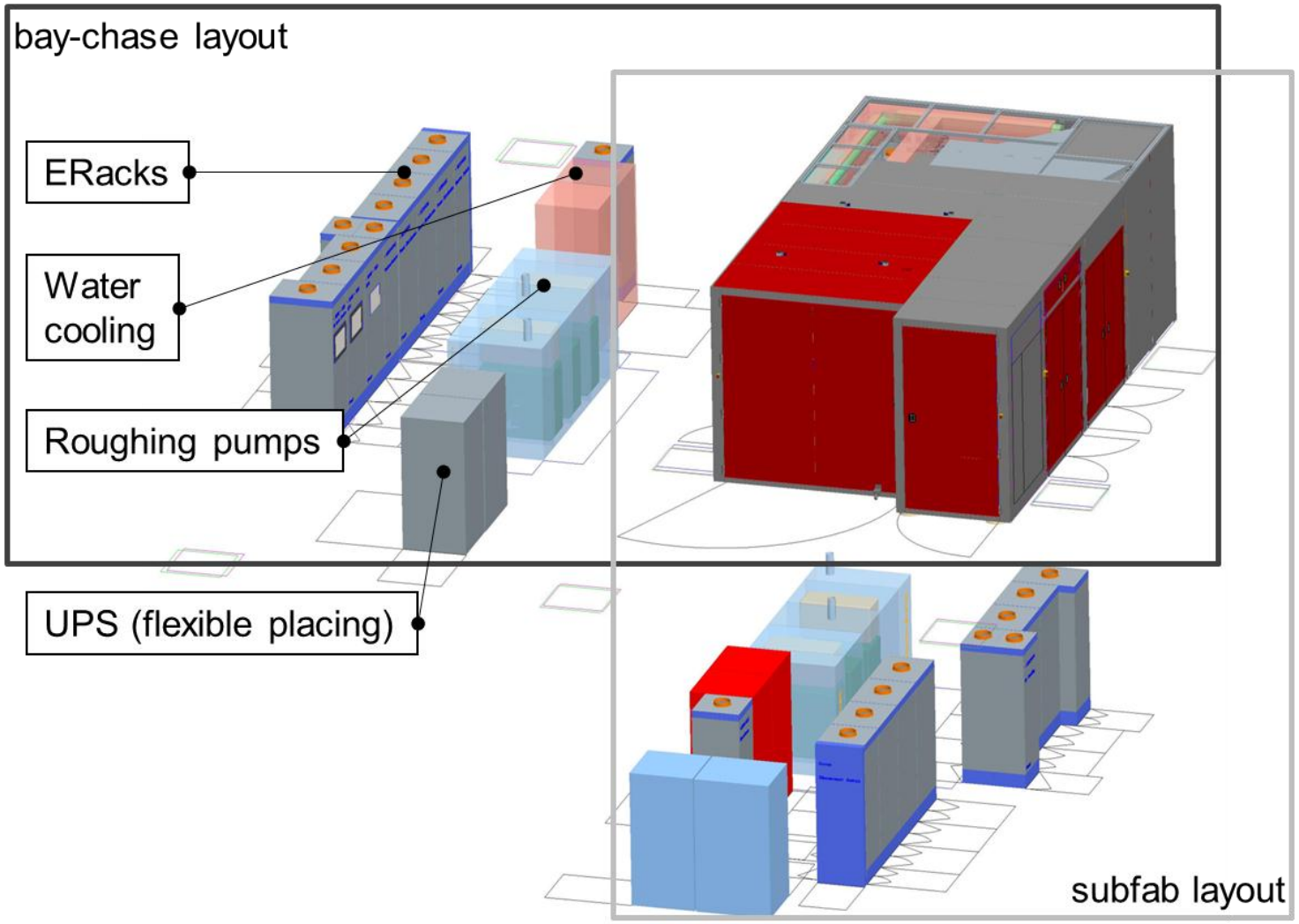
Agenda

Status of the Project

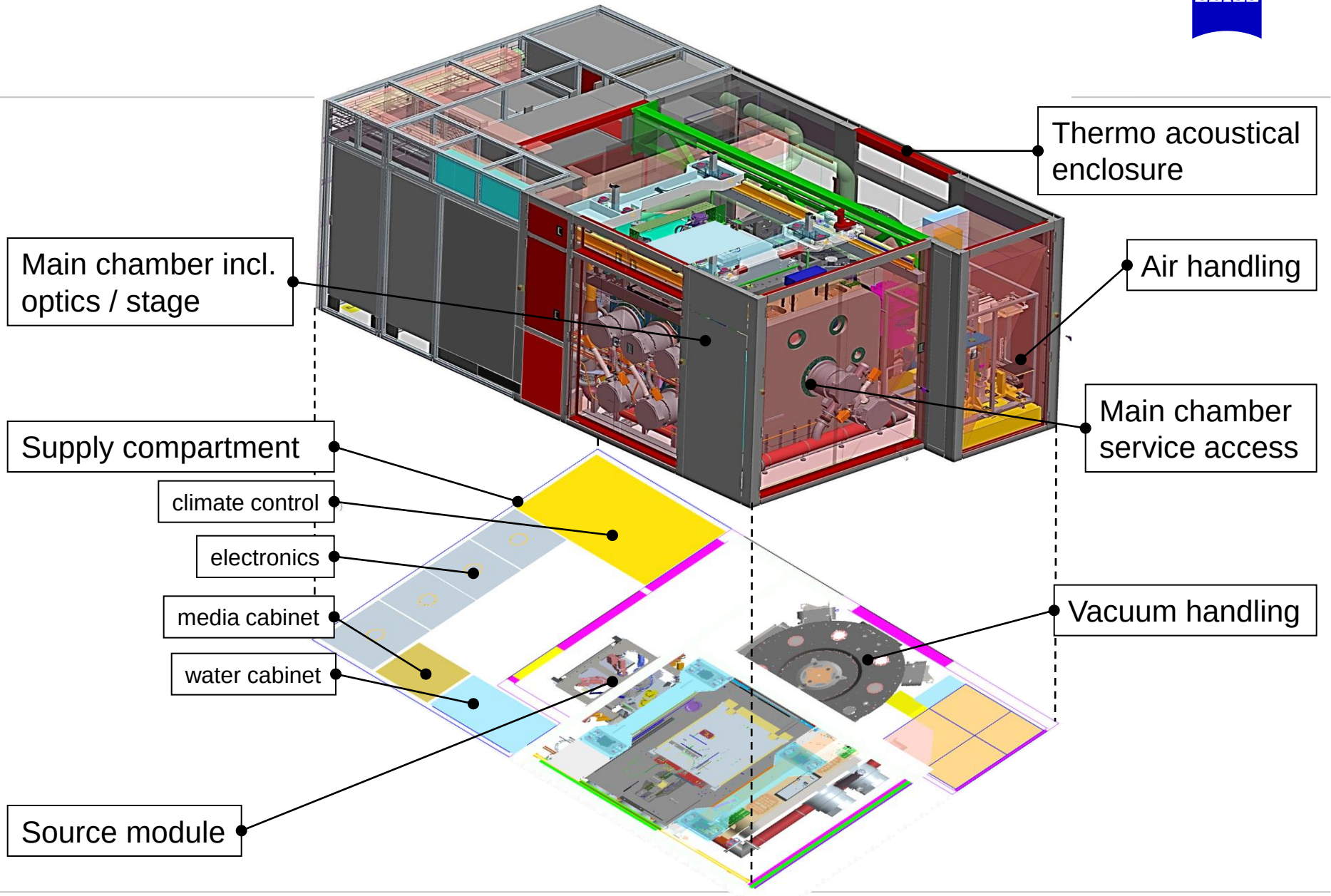
- AIMS™ EUV Project started mid of 2011
- Project on track
- Final Design Milestone successfully passed
  - Tool layout fixed for two configurations (sub-fab and bay-chase)
  - All components ready for production
  - Some components already in manufacturing
  - Simulation of tool final performance conducted



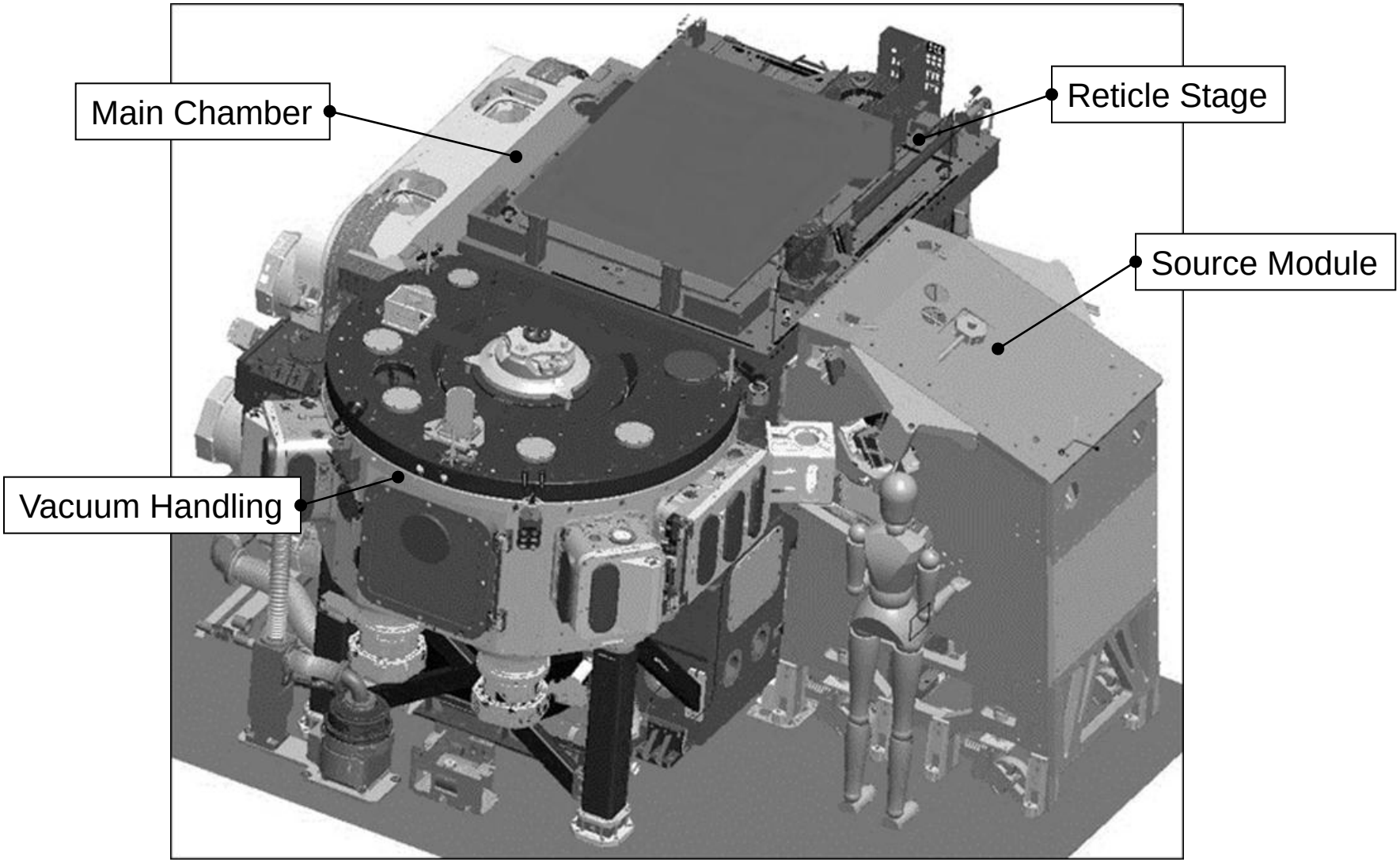
AIMS™ EUV layout



AIMS™ EUV cleanroom layout



EUV Metrology Core (EMC)



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Performance Simulation

Basic flow

- Performance of components are derived from
  - Optical simulation
  - Statistical behavior
  - Budget breakdowns
  - Test stand measurements
- Performance of all major specifications checked in the area of
  - Measurement speed
  - Source performance
  - Optical component performance
  - Resolution, Reproducibility, Location Accuracy
- Results of Simulation compared to Acceptance Test criteria

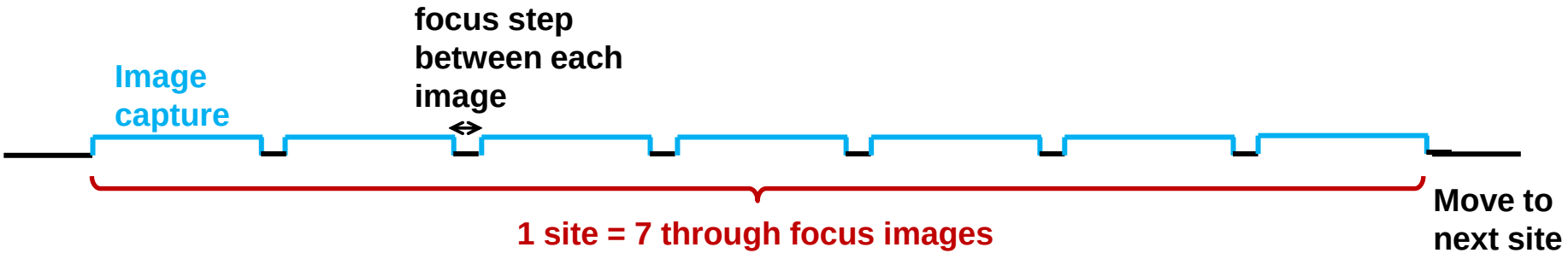
Measurement Speed

Run rate determined by

- Source brightness (dominant factor)
- Camera read out speed
- Stage movement

Measurement procedure

- For a given pupil fill capture 7 focal plane images per site



Specification	• Standard mode ≥38.5% pupil fill 28 sites per hour • Standard mode ≥77% pupil fill 51 sites per hour • Fast mode ≥38.5% pupil fill 56 sites per hour
Result	• In specification

Source Performance

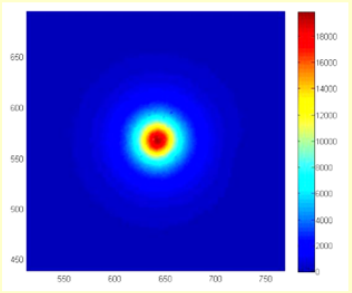
Source input parameters for simulation measured from test stand data

- Size stability
- Location stability
- Spectral stability
- Pulse energy stability
- Brightness

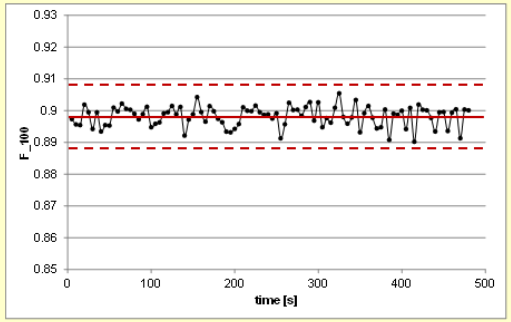
Source output data used for

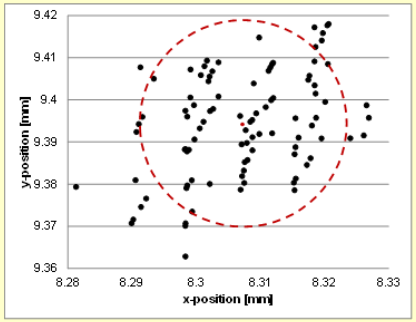
- Dose stability
- Pupil intensity
- Run rate

Exemplary CCD-Image:



Size and position (exemplary):



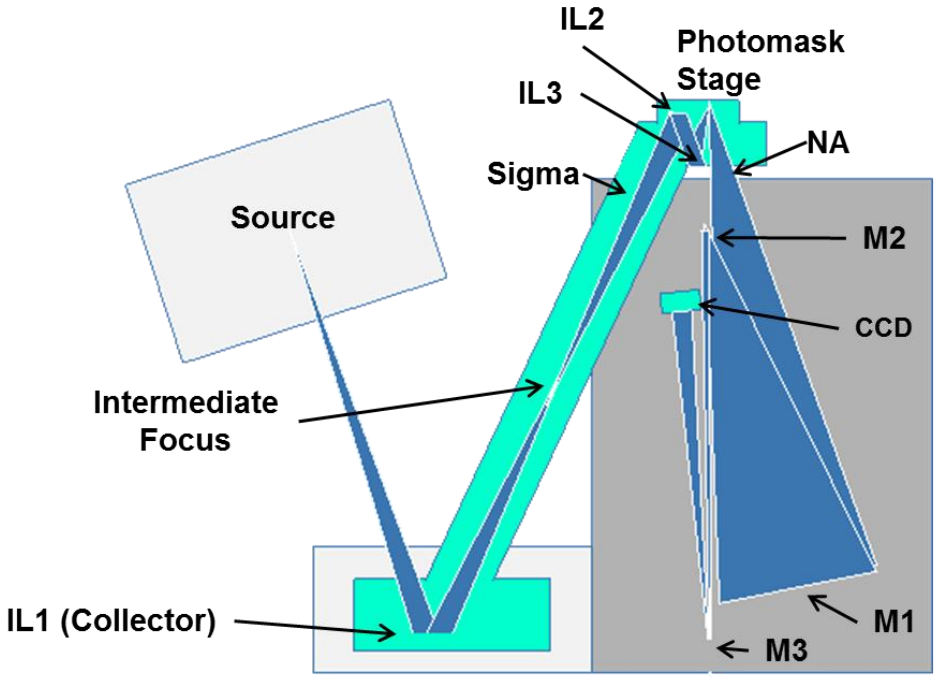


Optical performance

Mirror performance derived from budget
- Mirror surface figure
- Coating errors
- Assembly
- Metrology errors

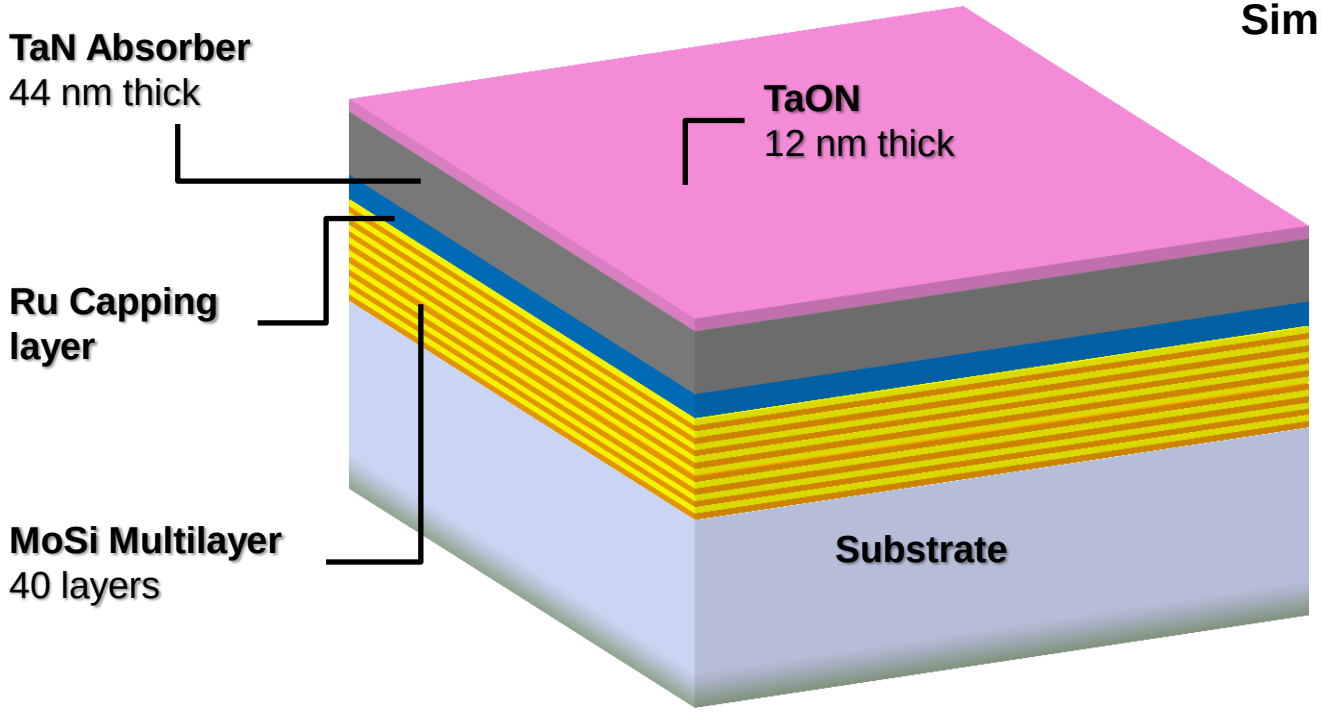
Mask simulated in 3D with S-Litho
- Complete stack information
- Different illumination conditions

Image contrast
- Monte Carlo input for parameter variations



Mask Stack Simulation Parameters

Simulator: S-Litho



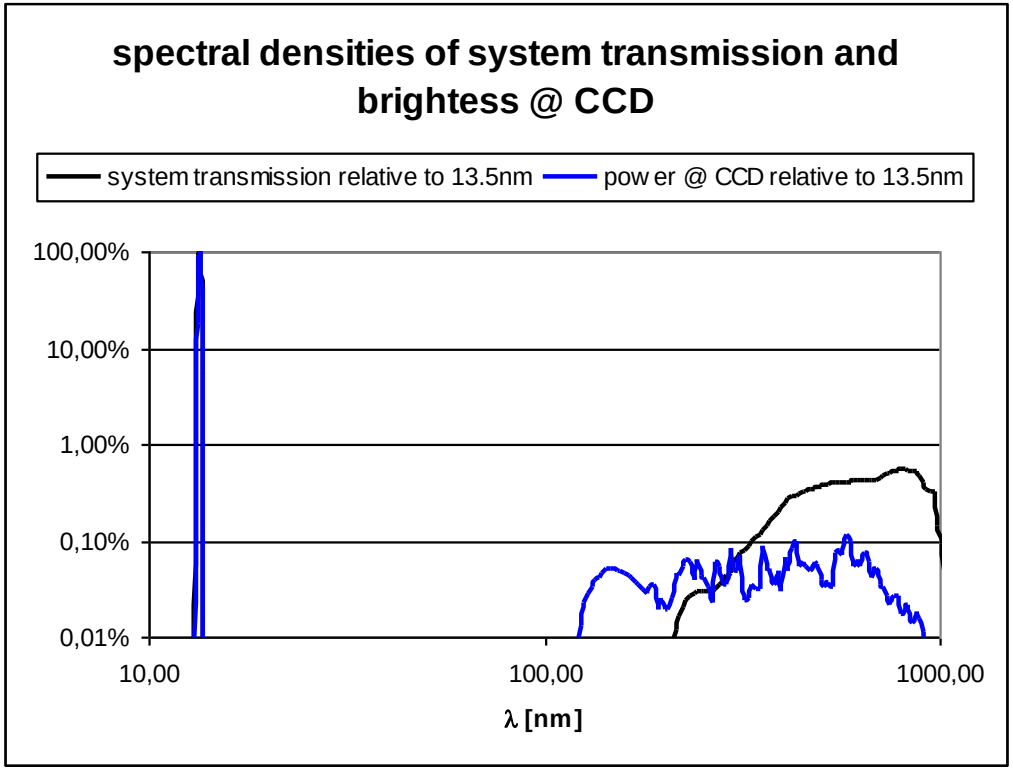
Illumination settings utilized:

NA	0.33/4	0.33/4	0.33/4	0.33/4	0.33/4
Illumination Type	**Dipole-x**	**Dipole-y**	**Annular**	**C-Quad**	**Quasar**
Sigma's geometric	0.20 - 0.90	0.20 - 0.90	0.65 - 0.90	0.20 - 0.90	0.20 - 0.90

Out-of-band Contribution

Input data for simulation:

- 180nm-1100nm source spectrum measured and extrapolated to 120nm
- literature values for spectral purity filter transmission and gas absorption
- reflectivity and stray light loss measurements of mirror coatings
- supplier information on spectral quantum efficiency of CCD chip



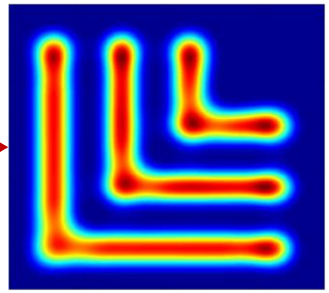
Specification	Out-of-Band power in the 120nm to 400nm wavelength range < 1%.
Result	In specification

CD Reproducibility

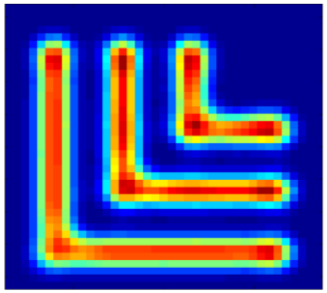
Simulation Conditions

- Imaging/Illumination: NA 0.33, Dipole 90°, Sigma 0.20/0.90
- Source performance as measured on source test stand
- Features at mask level
  - 64 nm lines with 128 nm pitch
  - 76 nm lines with 384 nm pitch

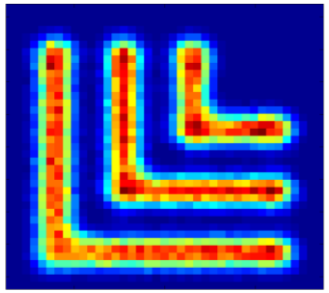
1. Simulate aerial image on fine grid



2. Pixelate according to CCD pixel size



3. Apply photon noise to each pixel



(Noise over exaggerated)

4. Determine CD with specified averaging

CD_i = xy nm

Repeat many times

Specification	• Best focus: CD-Repro (3-sigma) ≤ 1.5 nm (mask level)
Result	• In specification

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Summary

- Performance of AIMS™ EUV at final design simulated w.r.t. final acceptance criteria
- Design meets or exceeds the specification set
- Several long lead items already in production
- Project on track for prototype in August 2014

Acknowledgements

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We make it visible.